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EDITORIAL.

Pineapple Diseases.

The transition of pineapple cultivation from a catch crop with rubber to a sole crop has introduced new problems, one of which, manuring, was discussed recently in these pages: in the present number we introduce another important aspect, namely, diseases.

Under catch crop conditions pineapples occupied the ground for about five years, being gradually superseded by the permanent crop. The incidence of disease is less likely to assume serious proportions in a catch crop than when the crop is treated as more or less permanent. The present policy in pineapple cultivation is to grow the crop on the same site without interruption so long as manuring and other means are effective in maintaining profitable yields.

In anticipation of the growing importance of pineapple diseases, therefore, the Department of Agriculture has carefully surveyed the field for research in this country and has examined the diseases present to obtain an estimate of the relative importance of each.

As an outcome of this enquiry, a preliminary report on the fruit rots of the Singapore canning pineapple is the subject of an article by Mr. A. Thompson, Senior Plant Pathologist, which appears in this number. The author has prefaced his investigations by a brief account of the work on this subject in other countries.

Mr. Thompson deals with three fruit rots which occur in Malaya, namely, Fruitlet Brown-Rot, Broken Core, and Fruit Collapse, and outlines the research work carried out, and in hand, to ascertain the cause of each and to discover practicable methods of control.

The author states that from observations made in the factory, slight infection of Fruitlet Brown-Rot is found in 15 per cent. of the fruits received in the factory, moderate infection in 2 per cent., and severe infection in 0.6 per cent., while 2 per cent. of the fruit is affected with Fruit Collapse. These figures need cause no alarm, but they are of sufficient significance to justify the continuation of the research work already commenced on this subject.

Quinine. The first agricultural activities at the Experiment Station, Cameron Highlands, took place in 1924—six years before the road to the Highlands was completed—when nursery beds of *Cinchona succirubra* and *Cinchona Ledgeriana* were planted by the Department of Agriculture. The work on this crop was continued until about five or six years ago, when a demand arose for synthetic preparations to replace quinine, for example plasmoquine and atebrin, and for a time it seemed possible that such preparations might gradually replace quinine in the treatment of malaria. This vogue for synthetic preparations concided with the world-wide trade depression. For these reasons, the experimental work with cinchona on the Highlands was left in abeyance.

Recently, however, the question of increasing the supplies of quinine within the Colonial Empire has been raised. As a result, a further programme of experimental work with this crop on the Highlands has been laid down.

In connexion with this work, the authors of an article in this number record the results of analyses of the quinine content of the bark of *Cinchona Ledgeriana* cultivated at the Highlands under varying conditions. They conclude that the quinine content of these trees is promising, being rather higher than figures usually quoted for average Indian bark, but slightly less than those for Java bark.

Original Articles.

PINEAPPLE FRUIT ROTS IN MALAYA

A Preliminary Report on Fruit Rots of the Singapore Canning Pineapple.

BY

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Introduction.

The pineapple is a collective fruit, *i.e.* one in which a number of individual fruits coalesce. Each "eye" in a mature fruit represents a floral portion of one of these individual fruits or fruitlets. The remains of the withered floral parts usually persist in the hard-walled cavity situated beneath a closed "eye". Beneath each one of these floral cavities is the juicy placental region of the fruitlet in which there are three long narrow chambers, which contain the ovules or potential seeds. While the floral cavities are brown and hard-walled the fibrous, juicy inner tissue of healthy fruits is white or golden in colour.

In some types of fruit the placental region, beneath one or more of the floral cavities, may be brown and hard-walled due to a structural defect in which the openings of the seed chambers do not close when flowering has finished, but remain open or split open and, in consequence, the walls of the chambers may harden and become brown (1). Fruits of this type are said to have "deep eyes", and are considered to be undesirable owing to the waste involved through discarding the fruit or by cutting out the brown portions when preparing the fruit for canning. The term "deep eyes" is also used locally in connexion with types of fruits in which the floral cavities are deeper than is desirable, but in which hardening of the walls of the seed cavities has not necessarily occurred. Fruits with "deep eyes" may be quite free from any decay in the tissues, or they may be affected by a brown rot, which is usually confined to individual fruitlets. This brown rot may also occur in fruits with "shallow eyes" and, since the rot is located mainly in the placental region of one or more of the fruitlets, the disease may conveniently be termed "fruitlet brown-rot". This disease is very common in fruits brought to the canning factories in Singapore and Johore, but is not as much in evidence in the fruits grown in the coastal districts of Selangor.

Another form of fruit rot may occur in fruits in which the core is broken. The break is more frequently situated near the base or middle of the core, and here a cavity is formed. Probably as a result of dislocation of the food supply the portion of the fruit above the break turns yellow earlier than the portion below, and frequently a brownish rot develops in the core at the top of the fruit and extends down the core and laterally into the flesh adjoining the break.

A third type of rot, which up to the present has been recorded only in Johore, is characterized by the sudden collapse of a mature fruit which does not appear to have ripened. According to the growers, an apparently healthy, growing fruit may become entirely decayed with a soft rot within 24 hours, or, if picked when apparently sound, may decay during the journey to the factory. This disease is at present called "fruit-collapse".

Brown Rot of Fruitlets Reported from Other Countries.

The literature on pineapple fruit and fruitlet diseases published in Hawaii is not available to the writer for direct reference, but Johnson (2) in his recent book on the pineapple has summarized the information obtained in that country by Larsen (3) and Sideris and Waldron (4) working on diseases of the Smooth Cayenne pineapple.

Serrano in the Philippines (5&6), Barker in Haiti (8) and Johannson in Guatemala (9), have also studied the brown fruitlet rots of the Smooth Cayenne variety. This type of disease has been known for many years and has in the past been ascribed mainly to fungi which are normally saprophytes.

Larsen in 1910 suggested that the fungus Fusarium was responsible for a brown fruitlet rot to which Sideris and Waldron (1930) gave the name "Exogenous Brown Discoloration". These authors described this disease as being characterized by the absence of hardness and crispness of affected tissue, and considered that it was due to a saprophytic fungus—Penicillium—growing on devitalized or dead tissue.

Barker in 1926 and Serrano in 1928 concluded that a yellow bacterium, called *Erwinia ananas* (or *Bacillus ananas*) by Serrano, was the cause of a fruitlet brown-rot in which hardness of the affected tissue was a marked feature of the disease. These authors considered that Penicillium was probably a secondary fungus.

Sideris and Waldron (1930) considered that the brown rot, characterized by hardening of the tissues of the fruitlet, is due to a white bacterium, which is not an aggressive parasite but grows on the withered floral parts and develops on stored up food substances causing gradual atrophy and death of the tissues. These authors called the disease "Marbled Fruit Disease".

In the following year (1931) Serrano (6) recorded fruitlet "black-rot" in the Philippines. This disease appears to be almost indistinguishable from his fruitlet "brown-rot" and he states that it is caused by a parasitic white bacterium which he named *Phytomonas ananas*. In 1934 Johannson (9) described a brown fruitlet rot in Guatemala and generally confirmed the observations of Barker and Serrano that a yellow organism (*Bacillus ananas*) (*Erwinia ananas* ?) is the cause of the disease.

Johnson (*loc. cit.*) suggests that the fruitlet rots attributed to Penicillium from Queensland and Jamaica and a disease called Black Spot from South Africa are the same as Larsen's disease and the disease called "Exogenous Brown Discoloration" by Sideris and Waldron.

Discussion.

From the information summarized above it appears that brown fruitlet rots are regarded as being of two types, one associated with bacteria and the other associated with fungi.

In this connexion, the invariable presence of *Penicillium* spp. on the decaying floral parts which persist in the floral cavities when the "eyes" become closed is of interest. Serrano has shown that his yellow bacillus is also present on the floral parts soon after the flowers open, and it is very probable that the bacteria and fungi associated with fruitlet rots are the common agents of natural decay of the flowers. Ants are usually present in the flowers, and since the basal flowers open first and have decayed by the time the upper flowers are opening, ants travelling from decaying flowers to open flowers will inevitably carry the common organisms with them and, consequently, the organisms associated with natural floral decay are usually of the same type in every flower. Hence it is not surprising to find that, when for some reason the tissue of a fruitlet becomes susceptible to decay, one or more of the organisms present in the floral cavities are associated with the internal decay.

The fact that the rot in the majority of instances affects only a few fruitlets and rarely extends to adjacent fruitlets suggests that the affected tissue has become altered in some fashion, so that either the natural resistance to saprophytic invasion is lowered or the protective mechanism in the fruitlet has failed and has permitted certain organisms to enter the placental region and become established in the cells which contain food suitable for growth and maintenance of the type of organisms concerned. Serrano states that the yellow and white bacteria can enter the placental region through cracks which may occur in the hard lining of the base of the floral cavity, or through ruptures in the fissures (three in number) connecting the floral cavity with the placental lobes, and remain dormant until the fruit begins to ripen, and then grow and multiply when suitable foods (mainly sugars) are elaborated.

This theory suggests that only those fruitlets which are imperfectly protected will be affected, and that the organisms will operate only when the food in such a fruitlet favours their growth, and would explain the occurrence of the two types of fruitlet brown-rot, since Penicillium operating in the absence of bacteria might produce an effect on the tissues (*e.g.* absence of hardness) different from that produced by bacteria operating alone or accompanied by Penicillium.

The identity of Barker's and Serrano's yellow bacteria (and of Serrano's white organism with the white organism isolated by Sideris and Waldron) has not been proved, but it appears to be probable that the bacterial diseases referred to by these authors, if not absolutely identical, are of the same type.

According to Johnson (2) the disease, while of importance in Haiti and the Philippines, is not of great importance in Hawaii. Serrano in his paper on control of pineapple fruitlet rots (7) considers that this is due to a difference in the acidity of the Smooth Cayenne fruits in the two countries, a matter to which reference will be made later.

Fruitlet Brown-Rot of the Singapore Canning Pineapple in Malaya.

Symptoms.

External signs of the presence of this disease in a fruit have not been noticed in any of the normal specimens examined up to the present.

When the skin of an affected fruit is cut away to a depth which just removes the floral cavities the brown rot is very obvious if it has progressed to any extent in the diseased fruitlets, and even if the rot is at an early stage the brown colour of the top of one or all of the three placental lobes of the fruitlet cannot be mistaken (see Plate 1 centre fruit and Plate 2, which is a "close up" of the affected portion of the centre fruit in Plate 1).

The fruitlets in the middle or at the base of the fruit are usually more severely affected than those near the crown.

On cutting through an affected fruitlet the inward extent of the rot can be seen. Sometimes the rot is extensive, reaching to the core, but more frequently it is about a quarter or half an inch in depth and does not usually extend beyond the base of one or more of the ovarial loculi (Plates 1, 3 and 4). The brown tissue is harder and slightly drier than healthy tissue.

When two adjacent fruitlets are both badly affected the rot appears in cross section as a wedge of brown, almost black, decay extending to the core, and in such cases there may be a red brown margin at the core or at the side of one or both fruitlets (Plate 1).

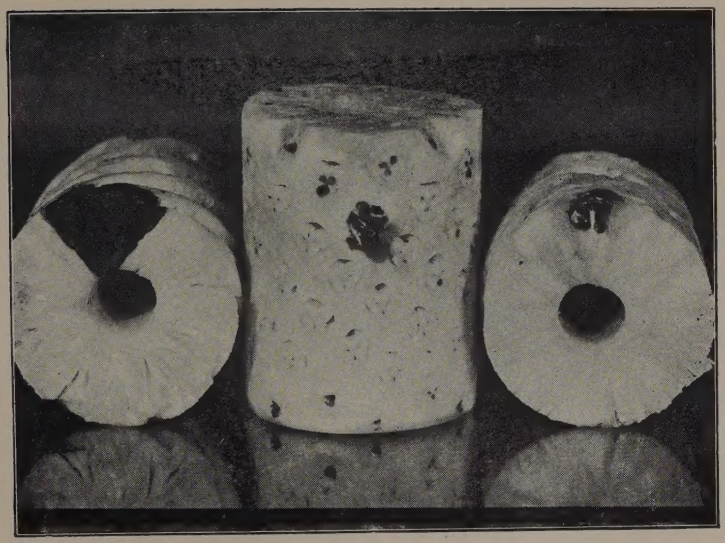
The usual colour of the diseased tissue is (as described by Serrano) bone brown (Ridgway's "Color Standards and Nomenclature"). There is normally no distinctive smell from the fruitlet and the tissue is not slimy or noticeably disintegrated, but is frequently rather tougher and harder to cut than healthy tissue.

The ovarial loculi are sometimes lined with a skin or a "fluff" of white, fungus mycelium, standing out prominently white on the brown tissue (Plate 3 on the left).

Economic Importance.

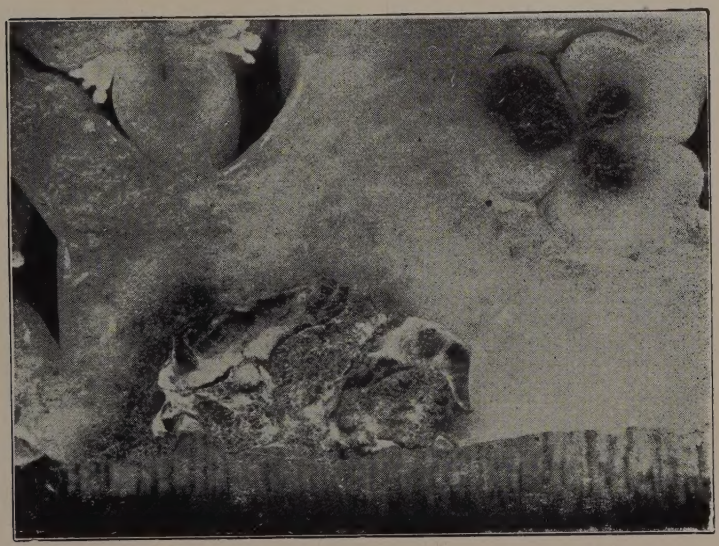
Observations and counts of infected fruits were made in the canning factories in Singapore, Johore and Selangor in March and July, 1936. On the cutting benches in Selangor factories the average number of fruits infected slightly (*i.e.* with one or two fruitlets affected) was 15 per cent.; moderately (several fruitlets affected) 2 per cent., and severely (many fruitlets affected) 0.6 per cent. In Johore and Singapore the figures were higher, ranging from 24 to 64 per cent. slight infection, and from 3 to 7 per cent. moderate infection. The percentage of fruits severely affected did not exceed 1 per cent. In general, the incidence of the disease appeared to be greater in the riper fruits, particularly those with golden flesh, than in the less ripe or the whiter-fleshed fruits.

Since the rot is normally confined to a definite area of the fruit, and the tissue bordering the decayed portion is healthy, it is often possible to cut out the rotted tissue and to use the remainder of the fruit for canning. In fruits cut spirally a skilful worker, when removing the "eyes", can usually remove the decay from

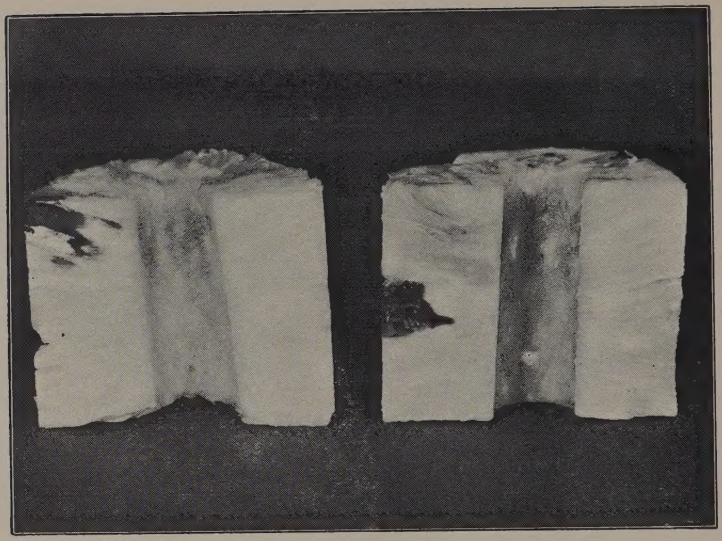


FRUITLET BROWN-ROT

Left: Two adjacent fruitlets badly affected.
Centre: One fruitlet in advanced stage: adjacent fruitlet in early stage.
Right: A typical case.



"Close up" of affected fruitlets of the centre fruit in Plate 1.



FRUITLET BROWN-ROT
Longitudinal Section
Left: White mycelium in the ovarial loculi.

FRUITLET BROWN-ROT
Extending in the ovarial loculi and placenta.

slightly affected fruits without appreciable waste. In the case of "cube-cut", however, one or two cubes may have to be discarded from each slightly infected fruit. There may be considerable waste in fruits moderately or severely affected with fruitlet rot, but at present it appears probable that the number of fruits so affected is low. Should the disease become more severe in the future and extend in the large areas now under pineapples as a sole crop, the increased waste of material might well become of economic importance.

Isolation of Organisms.

Numerous cultures have been made from the affected portions of fruitlets, and from fresh and withering floral parts. A primuline yellow bacillus, six types of white bacteria, yeasts and two or more species of the fungus Penicillium have been obtained in culture.

Potato-dextrose agar and beef-extract-peptone-dextrose agar (pH 6.4) are suitable media for isolation and growth of these organisms.

The skin of white mycelium which may occur in the ovarial loculi is almost invariably a species of Penicillium, but on one occasion from a coarser felt of mycelium, sterile, white mycelium resembling a type culture of *Marasmius palmivorus* was obtained. This fungus does not appear to be of importance in fruitlet rots but has been associated with a leaf disease of minor importance in backward pineapple plants: it also causes a rot of oil palm fruits.

The primuline yellow bacillus and *Penicillium* spp. have frequently been obtained in pure culture directly from diseased fruitlets and in other cases several organisms which appeared at the same time in the isolation tubes.

The yellow bacillus has been isolated more frequently than any other organism and has been obtained readily in cultures prepared from decayed floral parts of both diseased and healthy fruitlets, and from the base of petals and other floral parts of unwithered flowers. White bacteria and *Penicillium* spp. have also been isolated from fresh flowers, and, together with the yellow bacillus, appear to be the first organisms present on the floral parts when natural decay sets in.

Microscopic Examination of the Brown Tissue.

In sections cut from specimens of typical but early cases, bacteria alone have been found in the cells near the inner margin of the rot in a few instances. Hyphae of Penicillium are, however, commonly present at the margin and it is probable that, when Penicillium follows bacterial invasion, the hyphae can rapidly invade the brown tissue and may be present at the margin shortly after the brown rot ceases to extend inwards in a fruitlet.

The Yellow Bacillus.

A short-rod approximately 1.0 x 0.6 microns, motile, often in pairs, gram negative, spores not observed.

It is possible that two strains of this species are present in the diseased tissue, since two types of colonies have appeared in dilution separations, one type forming both circular and irregular colonies (numbered S1 and shown in Plate 6) and the other circular colonies only (S2 Plate 7). Sub-cultures from circular colonies flow readily on potato-dextrose agar slants while those from the irregular colonies spread with lobed projections. On beef-extract medium (pH 6.4) transfers from irregular colonies are transparent and lobate; those from the circular colonies are less lobate and are oleaginous at first, later becoming transparent. When either form is grown on litmus milk the medium is bleached and clotted in 5 to 6 days and a yellowish whey separates; the reaction is acid for 30 days in cultures from irregular colonies; the clot has by then disappeared and is replaced by a yellowish turbid liquid and a flocculent white precipitate. In 40 days a tinge of purple develops at the surface and the liquid is alkaline to litmus paper. Cultures from circular colonies react similarly but the change to alkalinity may occur within 30 days. Growth of both types is yellow on purple lactose agar, and gelatine is completely liquified. Colonies of both types on potato-dextrose agar are mainly circular, convex, primuline yellow, opaque; some are umbilicate and the margin may flatten and become crenate.

The organism answers to the description of *Erwinia ananas*, but the greenish-grey to violet-grey colour which Serrano occasionally observed in the mass accumulating at the bottom of the slant has not been observed, while the surface metallic tint of yellowish blue-violet, which Serrano generally noticed has only been seen in cultures contaminated by a white, fluorescent species.

The White Bacteria.

None of the six species of white bacteria isolated by the writer from diseased fruitlets exactly resemble Serrano's *Phytomonas ananas* since the greening of the medium, which appears to be a typical character of this species, has not occurred.

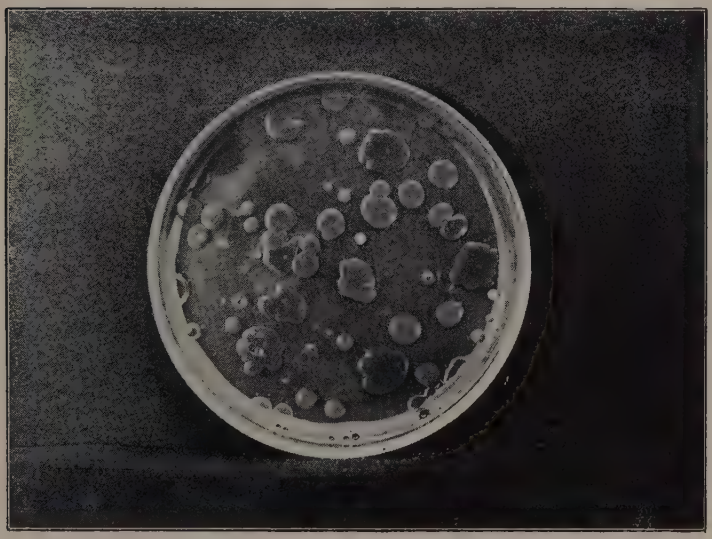
Only two of the six species have been isolated with fair regularity and these usually appear, in the isolation cultures, along with the yellow bacillus or Penicillium.

The six species have been numbered S 3, S 4, S 5, S 6, S 7, and S 8, and of these S 3 and S 4 are the two mentioned in the preceding paragraph.

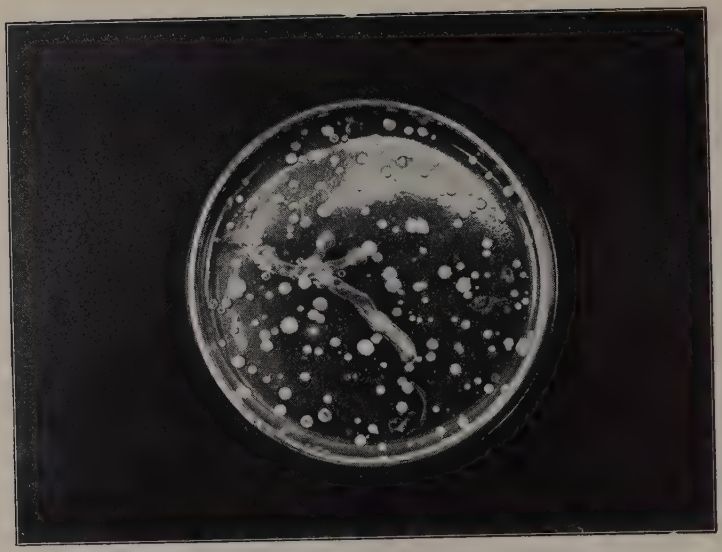
Except for the absence of greening of the medium, S 3 closely resembles *P. ananas*, whereas S 4 differs, in addition, in not forming a rennet curd in litmus milk. Umbilicate colonies of S 4, some with crenate margins, are illustrated in Plate 9.

The other four species of white bacteria are of infrequent occurrence and appear to be unimportant. S 8 has been obtained on five occasions from fruitlet brown-rot and also occurs in another disease ("Fruit Collapse"). It forms small, white colonies, 3 mm. in diameter; these later develop a pink tinge. No growth is apparent on purple lactose agar but a greenish tinge develops on the line of the streak and the colour of the medium fades slowly. There is no action in litmus milk and gelatine is not liquified.

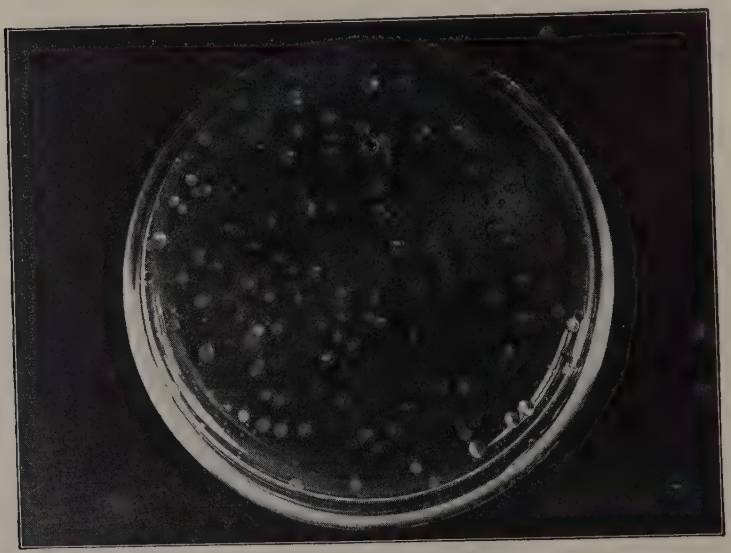
Fruit cut spirally in an unsuccessful attempt to remove the affected fruitlets.



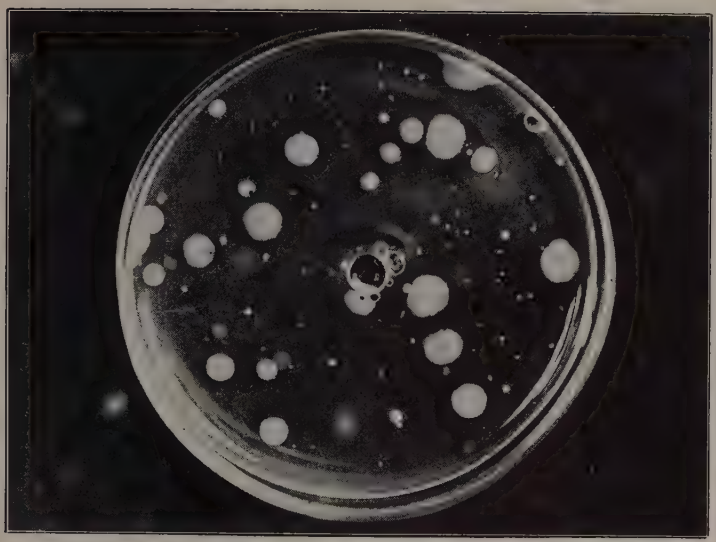
Colonies of S 1 on the beef medium.



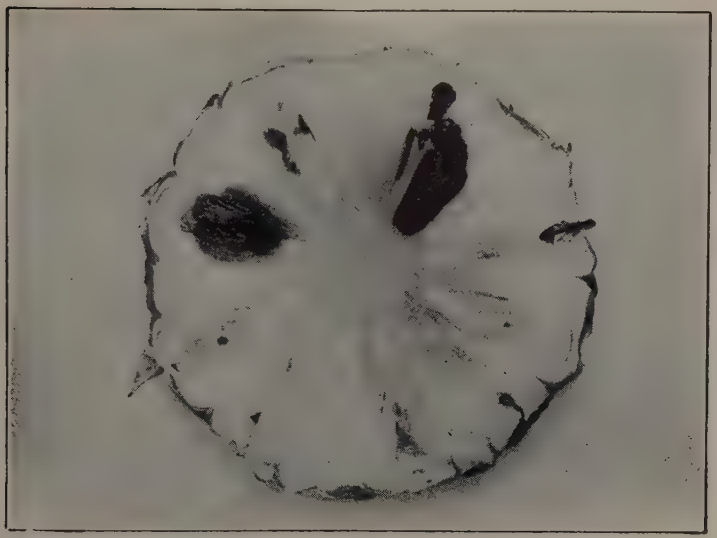
Colonies of S 2 on potato-dextrose agar (shewing a branched colony).



Colonies of S 2 on the beef medium.



Colonies of S 4 on the beef medium.



This fruit was inoculated when in flower by spraying with a suspension of the yellow bacillus. Fruitlet Brown-Rot was present 3 months later, and the organism was recovered in pure culture from the rotted fruitlets shewn above.

Fruit of Sarawak variety (a type of Smooth Cayenne). Wound inoculated on one side with the yellow bacillus. Control punctures on the other side did not cause rot. The organism was re-isolated.

Fruit with Broken Core shewing the bend at the top.

The Fungus Penicillium.

The various species of Penicillium which have been isolated from the brown tissue of the fruitlets have not yet been identified or studied in detail. The species most frequently obtained produces at first a mat of white or buff mycelium the centre of which turns green when the spores are formed. After four days a red colour develops in the medium fading with age to brown. This species is common on the withered flowers and was used for inoculations.

Inoculation of Fruits.

Preliminary inoculations with all the organisms isolated were carried out in a small plot of three rows of the Singapore Canning variety at Cheras Agricultural Station in Selangor on an area of sandy granite soil.

Growing fruits were inoculated when in flower, immature and mature, during the period April 1936 to March 1937, and some of these fruits were examined at different stages of growth. No rot had developed in inoculated fruits picked before they were mature and in the later inoculations the fruits were allowed to ripen before they were picked for examination.

Some of the growing fruits were surface sterilized with an alcoholic solution of mercuric chloride before inoculation, others were not treated. The inoculations were made by pricking with sterile needles to varying depths at the side of the floral cavities and then inserting the various organisms. A covering of melted paraffin wax was applied to seal the wounds in some cases. Inoculations were also made with suspensions of the bacteria in sterile water, injected into the placenta with a hypodermic syringe.

In the case of fruits in the flowering stage the organisms were either placed in the floral cavities with and without wounding or were sprayed or injected over the petals and into the flowers.

A convenient method of marking inoculated fruitlets is to snip off the tip of the bracts.

These inoculations are still in progress, and results are awaited from recent inoculations of fruits which were in flower in April 1937, at Cheras, and on an area of pineapples growing on peat. The results obtained to-date, however, do not suggest that any of the organisms isolated from fruitlets affected with fruitlet brown-rot are serious parasites, and indicate the necessity of obtaining further information as to factors which may have an influence on the development of the rot.

Summary of Results of Preliminary Inoculations.

Negative results were obtained when half-grown fruits or immature fruits which had finished flowering were inoculated by wounding. This may be due to the fact that the wounded tissue had become brown and hard-walled by the time the fruits were ripening, thus excluding the inoculum.

The positive results obtained to-date (*i.e.* development of a brown rot in the inoculated fruitlets and re-isolation of the organism used) have occurred only in fruits inoculated when mature or in the flowering stage with the yellow bacillus and with Penicillium. The presence of the rot in fruits inoculated when in flower might be the result of a natural infection. Inoculations by this method on a large scale and statistical analysis of the results will be required to establish that the disease can be induced by flower inoculations.

Table I includes a summary of the positive results obtained. In the case of fruits inoculated when mature, the tissue in which rot developed was not typically hard. In the case of flower inoculations the decay was typical.

Table I

Organism	No. of Fruits Inoculated.	Age of Fruits Inoculated.	Result.
S2 Yellow bacillus	25	7 mature	*4 positive. 3 negative (no rot)
		†8 flowering	*3 „ 5 „ „ „
		10 immature	0 „ 10 „ „ „
S1 Yellow bacillus	11	9 flowering	*1 positive. 8 negative (no rot)
		2 immature	0 „ 2 „ „ „
Penicillium	12	3 mature	*3 positive. 0 negative (no rot)
		5 flowering	0 „ 5 „ „ „
		4 immature	0 „ 4 „ „ „

† unwounded. * original organism re-isolated.

It will be observed that out of 48 inoculations only 11 gave positive results. Sixteen of the negative results, however, occurred in fruits inoculated when about half-grown.

Five apparently successful results were also obtained with bacteria S 3, S 7, S 8, and one with the fungus Thielaviopsis, but the original organism was not re-isolated. Instead, other bacteria or Penicillium developed in the re-isolation cultures. (Thielaviopsis was again isolated from the affected fruit but the fruit was over-ripe when picked and was being rotted by this fungus so that re-isolation was to be expected).

These results are summarized in Table II.

Table II.

Organism	No. of Fruits Inoculated.	Age of Fruits Inoculated.	Result.	Organism in Cultures.
S 3	10	2 ripening	rot in 2 fruits	S2 and Penicillium
		5 flowering	no rot	
		3 immature		
S 7	12	10 mature	no rot	
		1 ripening	rot present	S2
		1 flowering	„ „	S1
S 8	14	4 flowering	rot in 1 fruit	S3 and Penicillium
		5 mature	no rot	
		5 immature	no rot	
Thielaviopsis sp.	2	2 flowering	rot in 1 fruit*	S2 Thielaviopsis*
			no rot in 1 fruit	and yeasts.

* over-ripe when picked.

No rot developed in fruits inoculated with bacteria S 4, S 5, S 6, and with *Marasmius palmivorus*.

Some harvested fruits also were inoculated. In the case of ripe fruits extensive brown rotting associated with Penicillium and yeasts occurred in a few days. In mature unripe fruits a slight extension of a brown rot into the tissue, at the base and sides of the needle mark, occurred in the case of some inoculations with S 1, S 2, S 3, S 4, S 8, and Penicillium after 12 days and the organisms were re-isolated.

These fruits were surface sterilized and the wounds were sealed with wax. Control punctures remained healthy, and in some cases bacterial inoculations were negative. If the needle passes through the floral cavity a soft, brown rot, associated with Penicillium, generally develops as the fruits ripen.

The frequent isolation of the yellow bacillus and Penicillium from diseased fruits and the results obtained in the inoculations briefly described above indicate that the yellow bacillus and Penicillium appear to be the organisms responsible for the development of a brown rot in individual fruitlets, but the fact that positive results were not always obtained following inoculation suggests that some fruits may be resistant.

Suckers from apparently resistant and susceptible plants have been collected and planted at Kuala Lumpur to investigate the possibility of selecting resistant strains.

Factors Influencing Infection.

Serrano (7) considers that certain strains of Smooth Cayenne pineapples are resistant to fruitlet rots and that the types which produce abundant shoots around the fruit and hold the fruit erect are less susceptible because the fruit does not lean and expose one side to the sun. He also found that an acidity of pH 3.7 to 3.8 is almost prohibitive to growth of *E. ananas* and *P. ananas* in culture, and suggests that in Hawaii where acidity of Smooth Cayenne fruits is between pH 3.6 and 3.8 the fruitlet rots are mild because of the high acidity, whereas in the Philippines where acidity varies between pH 3.8 and 4.5 the less acid fruits are more susceptible to the disease and fruitlet rot is more serious and prevalent than in Hawaii.

It is the practice in Malaya to remove the crown and suckers (or slips) from the developing fruits, and very frequently the fruits lie with one side exposed to the sun. Such fruits, however, do not always become affected with fruitlet brown-rot.

With regard to acidity of the fruits the general range in Malaya is from pH 3.7 to 4.2, usually about 3.9, and the disease has been found in fruits in which the acidity of the expressed juice is as high as pH 3.85.

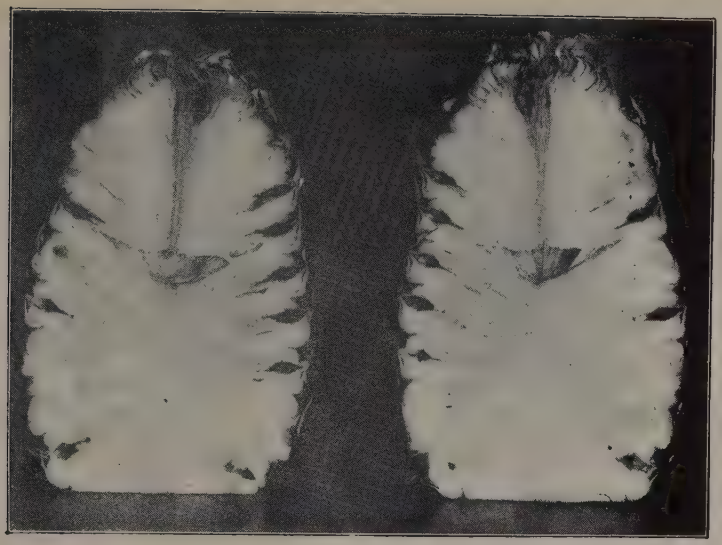
Consideration of Control Measures.

Serrano (7) found that fortnightly spraying of young fruits in flower during a period of three to four months with Bordeaux mixture or lime sulphur gave satisfactory results. Spraying, however, is prohibitively expensive and almost impossible to carry out effectively, so that this method cannot be considered locally.

Selection or breeding of non-susceptible strains appear to be more practicable methods of achieving control and, as mentioned above, the possibilities of selection are being investigated. General selection work, which has been in progress at the Pineapple Experiment Station, Singapore, for some time, should also give information on this point.

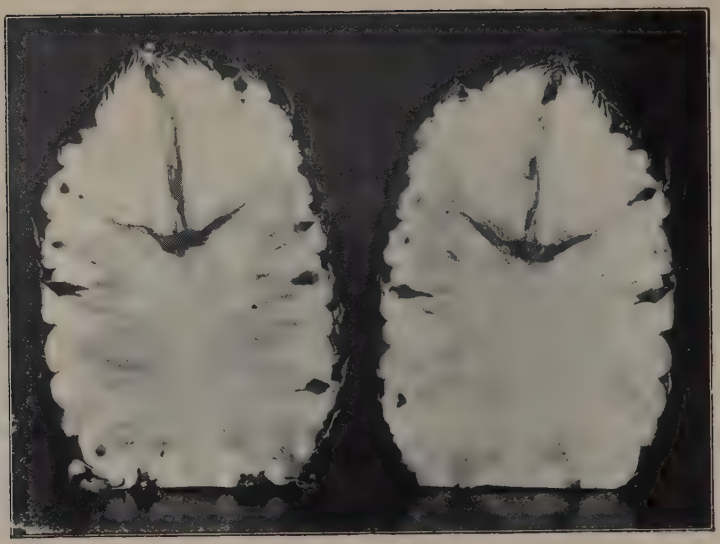
Recent work in the Philippines on manuring of pineapples and reported by Serrano (7) indicates that the Smooth Cayenne variety benefits considerably if manured with sulphate of potash applied in two equal replenishments during the tenth and thirteenth months. Fruits of plants receiving this manure showed increased resistance to fruitlet rots and the acidity of the juice was higher (pH 3.8) than that of untreated fruits (pH 4.0).

It is possible, therefore, that potash manuring may offer a method of control, but this will have to be experimentally verified before any recommendation can be made.

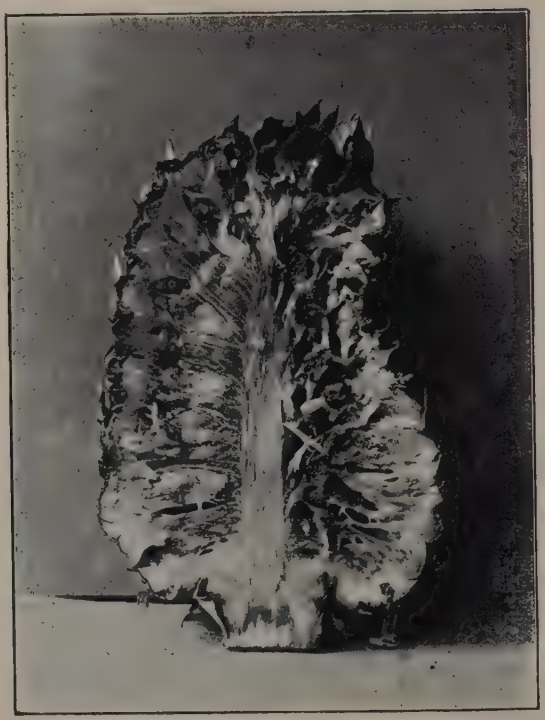


Broken Core. Tissue healthy.

Broken Core with rot extending below the break and into the flesh.



Broken Core with rot in the cavity and core.



A pineapple affected with Fruit Collapse, shewing the internal appearance of the tissue.

Conclusions.

Fruitlet brown-rot of the pineapple in Malaya is associated with the presence of bacteria and fungi in the inner tissue of individual fruitlets. Of the organisms isolated to-date a primuline yellow bacillus resembling *Erwinia ananas* and the fungus Penicillium are most frequently associated with the rot. The parasitic nature of these two and of the other organisms present is doubtful and it is therefore considered probable that the development of the rot in the tissues of a fruitlet is influenced by a combination of factors which results in the lowering of resistance to invasion.

It is thought that the most promising method of achieving control of this disease will be found in selection or breeding of resistant strains, and the adoption of a form of manuring which would help to inhibit the growth of the causal organism or organisms in the tissues without adversely affecting the quality of the fruits. It is hoped to continue work on these lines at a later date.

Broken-Core.

Broken-core is of frequent and universal occurrence in Malaya, but does not appear to have been reported from other pineapple-growing countries.

Fruits in which the core has broken usually ripen abnormally in that the upper portion turns yellow while the lower portion is still unripe, and frequently there may be a depression at the centre or the top may be bent to one side (Plate 12).

The photographs reproduced in Plates 13 to 15 show the internal symptoms, and the fact that the break may or may not be accompanied by a rot which extends down the core to the cavity, or below the cavity, sometimes extending into the tissues at the side of the core.

Some of the organisms present in fruitlet brown-rot are also present in the decay of the portion above the break but since rot probably follows dislocation of the food supply, which happens when the fracture occurs in the core, these organisms are probably saprophytes.

Although local growers incline to the opinion that the trouble is connected with decrowning and de-suckering, particularly if rain falls soon after this is done, fruits which have not been treated in this manner may also develop broken-core.

Observations are in progress at the Pineapple Experiment Station, Singapore, and, in time, may elucidate the cause of the trouble which is at present unknown.

Broken-core appears to be distinct from the "Crown Rot" and "Core Discoloration" due to yellow-spot virus [a disease described by Illingworth ([11]) and Linford ([12])] which is transmitted by *Thrips tabaci* and which causes a yellow streaking and rot of the leaves so that affected plants are tipped to one side.

Fruit Collapse.

This disease appears to be confined to Johore, where it was first noticed in December 1935 in fruits arriving by lorry at the canning factories. As a result of counts made later when visiting these factories it was estimated that on an average about 2 per cent. of the fruits in each lorry load were affected by this trouble.

The disease is said to develop suddenly, so that a fruit, apparently sound when picked, may within 24 hours be converted to a soft squashy mass. For this reason the fruits may appear to be sound when loaded on the lorries and yet arrive at the factory in the collapsed condition.

It was found that the disease also occurs in fruits growing in the field and that, in addition to those discarded on arrival at the factory, a number of fruits are usually rejected when the lorries are being loaded on the estates, so that the average losses apparently exceed 2 per cent. during the main fruiting seasons.

Externally, affected fruits are usually deep grape-green or yellow-olive in colour and have a dull appearance, are soft, and can be broken by hand. The inner fruit tissue is a homogeneous light dull-green-yellow colour, spongy, moist and somewhat shrunken due to absence of turgidity. The fruits may be lighter than normal due to leakage of juice, but usually contain quantities of liquid which bubbles out on squeezing the fruits. The tissue at first has a characteristic, sharp, rather acrid odour distinct from that of healthy pineapples and, in the specimens examined up to now, there is no marked odour of alcoholic fermentation, but in specimens kept for a day traces of fermenting smell can sometimes be distinguished. Diseased fruits are attractive to pineapple fruit beetles. Plates 16 and 17 show fruit affected with collapse.

In the tissue of the fruit a well-defined margin between healthy and diseased tissue has not been noticed in any of the specimens examined but, in some fruits affected while growing in the field, a brown margin was noticed either at the junction of stalk and fruit or extending down the stalk when the fruit was split open. (Plates 18, 19 and 20.)

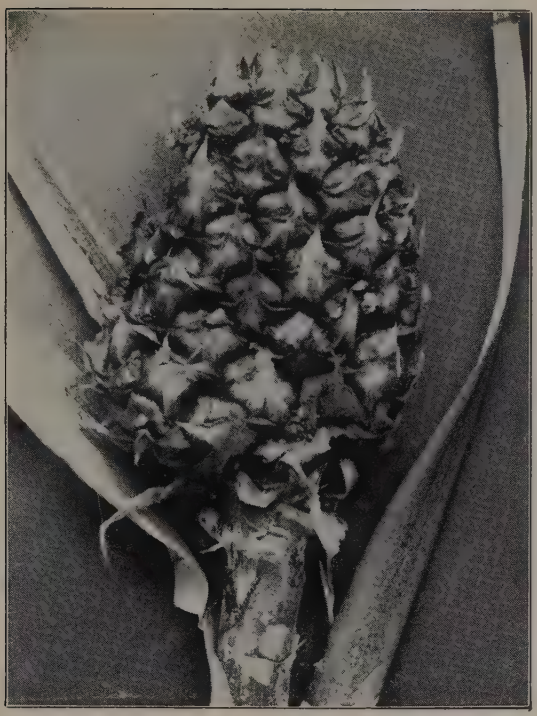
In the field, diseased fruits appear to occur singly and not in groups, but further observation on this point is required. It is known, however, that mature, healthy fruits, apparently in the same stage of development as a neighbouring diseased fruit, can ripen and remain healthy even if they are smeared with rotting tissue from a diseased fruit. Fruits on a Johore estate were inoculated when in flower, half-grown, and mature, with portions of a diseased fruit. It was reported that these fruits did not contract the disease.

According to Johnson ([2]) four types of fruit-rot have been recorded in other countries.

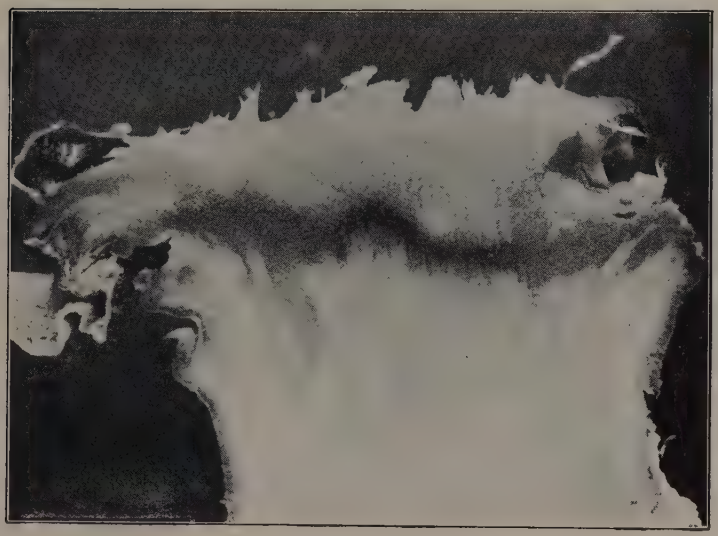
1. "Black rot", described by Larsen in 1910, is a storage rot of ripe fruits the tissues of which are blackened by the fungus Thielaviopsis.

2. "Green fruit-rot", described by Waldron in 1927 ([18]), which occurs in low-lying areas in wet weather in green fruits whose pH value is above 4.5. It is caused by *Phytophthora meadii* and has distinct symptoms.

3. "Ripe fruit-rot", described by Larson in 1910, sets in only after the fruits are thoroughly ripe. Thielaviopsis is not present and the fungi present are yeasts, Fusarium and Penicillium. Sideris and Waldron consider that this rot develops only on bruised or injured fruit.



External appearance of a pineapple affected with Fruit Collapse.



Fruit Collapse. Brown margin at junction of fruit and stalk.

Fruit Collapse. Rot ceased at junction of fruit and stalk.

Fruit Collapse. Rot extending down stalk.

4. "Fruit fermentation" considered by Sideris and Waldron (4) to be caused by yeasts which enter the fruit shortly before ripening and convert it into a fermenting mass. Pineapple beetles—*Carpophilus humeralis* (Fab.)—are attracted to the fruits. The authors state that the disease, about which little is known, is rare but causes serious losses whenever and wherever it occurs.

Of these four diseases "fruit fermentation" is possibly similar to the Johore disease "fruit collapse", but the available description is insufficient to determine this point.

Two species of bacteria, yeasts and the fungus Fusarium (on one occasion) have been isolated from diseased tissue. One of the species of bacteria is the white organism listed as S 8 already mentioned as occurring in diseased fruitlets. The other species, listed as S 9, is a short rod, gram negative, motile, developing a pink to red pigment on potato-dextrose agar. Litmus milk is coagulated in 6 days and a reddish pink clot forms with a copious, yellowish, strongly acid whey. Gelatine broth is liquified and the liquid turns brownish red.

Numerous inoculations with the organisms obtained from the tissues have been made on fruits growing at Cheras, Selangor, but the disease has not occurred.

Suckers obtained from plants affected with this disease have been planted at Cheras and Kuala Lumpur for further investigation.

Summary.

1. "Fruitlet Brown-Rot", "Broken-Core" and "Fruit Collapse" are the names given to three fruit diseases which occur in Malaya on pineapples of the Singapore Canning variety. These diseases are described and discussed and an account of preliminary investigations is given.

2. "Fruitlet brown-rot" appears to be similar to the disease recorded under this name in the Philippines and is associated locally with the presence in the affected tissue of a yellow bacillus which resembles *Erwinia* (*Bacillus*) *ananas*, frequently accompanied by species of the fungus Penicillium, and occasionally associated with white bacteria and yeasts, which are probably secondary. Brief descriptions of the bacteria are given.

3. The parasitic nature of these organisms is doubtful and it is considered probable that the development of the rot in a fruitlet is influenced by certain internal factors, *e.g.* a breakdown in the protective mechanism, coupled with other external factors which may be connected with temperature and which set up conditions in the tissue favourable to the development of the organisms concerned.

4. The adoption of a spraying programme being an impracticable control measure on grounds of expense and the difficulties involved, it is considered that the most promising method of achieving control will be found in selection or breeding of resistant strains, and the adoption of a manurial programme which may help to discourage the development of the causal organism or organisms in the fruitlets.

5. Fruits affected with "broken-core" usually ripen first at the top instead of at the base. In many cases a saprophytic rot travels down the core as far as, or below the break, and may extend into the tissues at the side of the core and render the fruit unfit for canning.

Although the local practice of removing the crown and suckers from young fruits is said to have some connexion with the incidence of broken-core, the cause of the trouble has not yet been determined.

6. "Fruit collapse" has been recorded only in Johore. It is said to develop rapidly, converting a normal, mature fruit into a soft, squashy mass in 24 hours. Bacteria, yeasts and *Fusarium* sp. are the only organisms so far isolated from affected tissue, and these have not reproduced the disease on inoculation. Suckers from affected plants are at present under observation.

Acknowledgments.

The writer gratefully acknowledges the assistance received from Messrs. W. J. B. Johnson and H. D. Meads who photographed many of the specimens.

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THE QUININE CONTENT OF *CINCHONA LEDGERIANA* BARK FROM CAMERON HIGHLANDS

BY

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and

GUNN LAY TEIK,
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Introductory.

Two visits have been paid recently to Cameron Highlands for the purpose of collecting for analysis samples of bark of *Cinchona Ledgeriana* (Moens) with a view to selecting trees with bark of a high quinine content for the vegetative propagation work being initiated in connexion with this crop.

A brief history of the crop is a follows. The seed, which was obtained from Java, was sown at the end of 1926 and the seedlings planted a year later in the field. The planting distance was 4 feet apart along terraces in the open. As the trees increased in age this distance was found to be too close and alternate trees were removed at the end of 1933.

A further planting of seedlings was made in May, 1929. In this case a light jungle shade was retained. The young trees were thinned out later similarly to those established in the open (1).

Experimental Work.

On the occasion of the first visit, in December 1936, six trees were selected, three trees from the open and three from under the light jungle shade. The trunks of the trees were sawn off at a height of about 1 foot from the ground. In those cases in which the tree had branched close to the ground only one limb was removed.

The portion of trunk removed in each case was cut into 3 ft. lengths, commencing from the lower end. The lengths were numbered consecutively, *e.g.* A1, A2, A3, A4. The fresh bark from each length was stripped by beating with a wooden mallet and air-dried to constant weight. Samples were drawn and analysed for total alkaloids and quinine content. Table I gives the details of the weights of air-dry bark and of the results of analysis.

The results indicate that while the yield of bark from the trees in the open is considerably in excess of that from those under light jungle shade, the figures for the total alkaloids and quinine content are of the same order in both cases.

The higher figures for yield of bark from the trees in the open can be ascribed to their increased age compared with those under light jungle shade.

The figures for quinine content are rather higher than those usually quoted for average Indian bark but slightly less than those for average Java bark, *e.g.*

Table I.

Results of Analysis of Samples of Whole Bark of *Cinchona Ledgeriana* from Cameron Highlands.

(Moisture-free Basis)

Reference Letter and No. of Sample	Situation of Tree	Weight of Bark	Total Alkaloids	Quinine
		ozs.	per cent.	per cent.
A1	Open	14.0	8.89	6.98
A2		10.7	9.53	5.94
A3		7.0	8.84	7.18
A4		2.7	6.69	5.03
		Average	8.90	6.54
B1	Do.	12.4	10.90	6.58
B2		8.9	10.86	6.38
B3		6.7	7.65	5.96
		Average	10.11	6.37
C1	Do.	27.2	9.40	6.64
C2		17.7	9.35	5.67
C3		12.2	8.60	6.23
		Average	9.21	6.25
D1	Light jungle shade	6.5	9.14	6.67
D2		5.0	8.09	6.08
D3		3.8	6.92	5.31
D4		2.1	4.93	3.60
		Average	7.84	5.83
E1	Do.	8.1	10.54	6.53
E2		6.2	9.09	6.84
E3		3.4	7.51	5.52
E4		2.2	5.50	4.50
		Average	9.00	6.22
F1	Do.	8.4	10.72	6.59
F2		7.5	10.41	5.97
F3		6.0	9.53	6.68
F4		5.2	9.64	7.80
F5		3.7	9.00	7.40
F6		2.4	8.66	6.36
		Average	9.92	6.73
		Average (all bark)	9.32	6.42

	per cent.
India	5.5
Cameron Highlands	6.4
Java	7.5

Following upon this work all the trees of this species were inspected in the early part of this year and sixty selected for the purpose of taking small samples of bark for analysis. Selection was based on vigour of growth and appearance of the trees. Twenty of the trees were in the open, the remaining forty under light jungle shade. The figures in the first experiment showed that up to a height of 6 feet from the ground there was no appreciable variation in the quinine content of the bark. The following method of sampling was therefore used. Discs of bark, 1 inch in diameter, were removed by means of a sharp steel punch at irregular intervals on the trunk up to a height of 4 feet. Care was taken not to wound the tree in the process and each exposed surface was immediately smeared with hot paraffin wax to prevent subsequent attack by insect pests or fungoid diseases.

The number of discs removed depended on the thickness of bark. About $1\frac{1}{4}$ ounces (35 grammes) were removed from each tree. This amount of fresh material, which corresponds to between 15 and 20 grammes of air-dried material, was sufficient for analysis.

Analysis comprised determinations of total alkaloids, quinine and cinchonidine. Table II gives the results of analysis for total alkaloids and quinine, the figures in each case being arranged in groups of 1 per cent. according to the situation of the trees.

Table II.

Results of Analysis of Small Samples of Bark of *Cinchona Ledgeriana* from Cameron Highlands.

(Moisture-free Basis)

A. Total Alkaloids

Limits of Group	No. of Samples	
	Trees in Open	Trees under Light Jungle Shade
per cent.		
14-13	1	2
13-12	2	7
12-11	7	11
11-10	8	13
10-9	1	6
9-8	1	1
Total	20	40

B. Quinine Content

Limits of Group	No. of Samples	
	Trees in Open	Trees under Light Jungle Shade
per cent.		
10-9	2	7
9-8	11	17
8-7	5	13
7-6	1	3
6-5	1	—
Total	20	40

The cinchonidine results have not been tabulated. This alkaloid was present in only very small amounts, the average figure for both series of trees being 0.09 per cent.

Remarks and Conclusions.

The results of analysis are promising. The figures indicate the presence of a large proportion of trees with bark of a high quinine content. For example there are no less than 37 trees, thirteen in the open and twenty-four under light jungle shade, in which quinine content is in excess of the average figures quoted previously for Java bark.

The results confirm those previously obtained as regards the absence of any correlation between situation of trees and quinine content, the distribution within the groups being of approximately the same order in both cases.

Further, in view of statements appearing in technical literature to the effect that the quinine content of the bark can be increased as a result of improved cultural conditions an increase in the alkaloidal content can be anticipated with the extra care and attention which the trees are now receiving.

Acknowledgment.

The writers wish to acknowledge the assistance of Mr. J. N. Milsum, Senior Agricultural Officer, and of the late Mr. E. A. Curtler, Agricultural Officer, Cameron Highlands, in the conduct of this investigation.

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A NEW METHOD OF HARVESTING, DRYING AND SAMPLING DERRIS ROOT

BY

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Introductory.

The necessity for a definite sampling procedure in connexion with the evaluation of commercial consignments of derris root was urged in a previous number of this Journal (1). A description was also given in that paper of a method which it was suggested might give satisfactory results.

Collaboration with an estate in Malaya exporting a large quantity of *Derris elliptica,* Changi No. 2, root has now allowed the method to be tested.

Since new methods of harvesting and drying were also employed, a detailed account will be given of the whole experiment which, it is thought, will be of considerable interest to estates and others engaged in the export of the root. Brief references to these new methods of harvesting and drying have already been made (2).

Harvesting of Root.

The usual method of harvesting consists in lifting the entire roots, avoiding damage thereto as far as possible.

In this instance no effort was made to preserve the roots intact. The stems of the plants were cut off just above ground level, and labourers, working at right angles to the rows of plants, removed the soil from round the roots with Assam forks to a depth of 1½ to 2 feet. Each labourer had in front of him a basket in which to place all portions of stem and root lifted during the process. Other labourers carried this material to a sorting shed in a corner of the field.

The freshly-harvested roots were roughly cleaned and all portions of stem removed. The marketable roots, that is roots of ½ inch diameter or less, were chopped into lengths of about 6 inches and sorted into two sizes. These may be designated fine roots and very fine roots respectively. The roots were packed into sacks according to size and despatched to the drying kiln, the numbers of the sacks with each size of root being noted.

Drying of Root.

The simple method used by the small producer is sun-drying until the root is brittle enough to snap when bent.

When dealing with a large crop, artificial drying must be undertaken. A flue-heated drying chamber is employed in which the root is dried at a temperature of 130°F. in about 3 days.

In this experiment the roots were dried on a kiln similar in design to a hot-table copra kiln, the fine and very fine roots being kept separate. In this way an economy in drying space could be effected, the very fine roots drying more quickly than the fine ones.

The average temperature on the kiln was about 140°F. and drying of the fine roots was complete in about 3 days.

The roots were turned over from time to time during drying. Practically all the soil adhering to the roots fell away during the drying process. The dried root was then removed to the baling shed.

Bulk Sampling of Root.

The amount of root required for a bale, say 220 to 240 lbs., was weighed, care being taken to ensure the correct proportions of fine and very fine roots as originally lifted. The root was mixed thoroughly and baled.

When half the quantity required for a bale had been loaded into the press, about 2 lbs. of the root were taken at random from the heap and set aside as a sample from that bale.

When 20 samples, say 40 lbs., had accumulated, the bulk sample of root was mixed, spread out in a thin layer on the floor and quartered until about 1 lb. remained. This amount was despatched to the Department for analysis.

Laboratory Sampling and Analysis.

The sample was cut into 1 inch lengths and quartered until about 3 ozs. (80 grammes) remained. This quantity was further cut into $\frac{1}{4}$ inch lengths and ground in the laboratory mill for analysis.

When quartering, care was taken to include dust and other small débris associated with the root to ensure the analysis being carried out on the material as baled.

Twenty-five samples covering 497 bales were analysed. The twenty-fifth sample was drawn from only 17 bales of root.

Determinations of moisture, rotenone and ether extract were made according to the methods described in the number of the Journal referred to previously (1).

The results of analysis are given in Table I.

The figures for moisture have not been included in the table, since the principal object of the experiment was to ascertain the extent to which rotenone and ether extract varied with each group of 20 bales. This can only be done by comparing all figures on a moisture-free basis.

In addition to the rotenone and ether extract figures, those for the proportion of rotenone to ether extract have also been included to show the range of variation in this respect. These figures are of some importance as experience shows that for each variety of root there is an approximate relationship between rotenone and ether extract. Thus, for *D. elliptica*, Changi No. 2, the proportion of rotenone in the total ether extract is about 30 per cent.

It is interesting to note that the average figures for both rotenone and ether extract for the whole consignment are in reasonably close agreement with those found for a number of individual plants of the same race grown at Kuala Lumpur, as the following figures, expressed on a moisture-free basis, show (3).

	Rotenone	Ether Extract	Proportion of Rotenone to Ether Extract
	per cent.	per cent.	per cent.
Commercial consignment ...	7.18	23.29	29.6
Individual plants ...	6.60	22.05	30.0

Table 1.

Variation in Rotenone Content and Ether Extract of 25 Samples of Derris Root.

Variety - *Derris elliptica*, Changi No. 2.

(Moisture-free Basis)

Serial No.	Rotenone	Ether Extract	Proportion of Rotenone to Ether Extract
	per cent.	per cent.	per cent.
1	8.08	24.49	33.0
2	6.98	24.38	28.6
3	7.55	23.50	32.1
4	7.79	27.33	28.5
5	7.86	25.27	31.1
6	7.30	26.04	28.0
7	8.85	25.00	35.4
8	8.19	25.00	32.9
9	8.46	26.30	32.2
10	7.43	24.78	30.0
11	7.73	25.85	29.9
12	7.82	26.40	29.6
13	6.50	23.93	27.2
14	6.82	23.14	29.5
15	7.22	24.75	29.2
16	6.02	22.63	26.6
17	5.62	21.14	26.6
18	6.13	23.39	26.2
19	7.10	22.20	32.0
20	6.16	21.96	28.1
21	6.72	22.67	29.6
22	6.68	25.29	26.4
23	6.91	24.50	28.2
24	6.62	23.21	28.6
25	6.98	24.30	29.4
Maximum	8.85	27.33	35.4
Minimum	5.62	21.14	26.2
Average	7.18	23.29	29.6

Remarks and Conclusions.

Both handling and drying of the material are facilitated as a result of chopping the fresh roots in the field as described.

The sorting of individual pieces of fresh root also ensures a minimum proportion of stem, since it is much easier to distinguish root and stem in the fresh than in the dry state. This is an important point since sellers are penalized for the presence of stem in the root.

If fresh roots are chopped there is a complete absence of dust; this is important from the point of view of the health of the labourers. When dried root is chopped labourers complain invariably of a dryness in the throat; this can be obviated to a certain extent by ensuring that labourers engaged in such work wear a respirator pad over the mouth. The pad should be kept moist.

The great advantage of working with chopped root is, however, the substantial reduction in freight charges which can be effected. As pointed out previously (2), a bale of ordinary root, the overall measurements being 42 ins. x 30 ins. x 28 ins., contains approximately 175 lbs. If the root is chopped as described, the net weight of root in a bale of those dimension can be increased to about 240 lbs.

For two reasons buyers do not at present favour this method of exporting chopped root. In the first place it is urged that the adoption of such a practice may lead to adulteration. Since all root is sold on analysis it seems hardly likely that a seller is going to penalize himself by mixing roots of other plants with his product.

A more important objection is the alleged deterioration of the root when chopped. This alleged liability to deteriorate is not supported by the results of experiments carried out in this Department. *D. elliptica*, Changi No. 3, root has been stored for nearly a year in this state without any change occurring in either its rotenone content or ether extract. The same remark applies equally to the powdered root. Provided the powder is stored in a dry container and is not exposed to the light, the toxic content remains unaltered.

As regards the results of analysis, the figures for rotenone and ether extract emphasize the necessity for a standard method of sampling.

Although the variation in toxic content between any two groups of 20 bales is much less than that found between the roots of two individual plants, the degree is too wide to allow of any reliance being placed upon the results of analysis of a single sample selected at random. The present solution of the difficulty would appear to lie in a mutual arrangement between the parties concerned as regards a definite sampling procedure, the important points being the amount to be drawn from each bale when the root is being pressed, or the number of packages to be opened and the amount to be drawn from each bale if the root is already packed.

As stated previously (1) the first method is preferable, since no repacking of the bales is involved. Further, apart from the labour involved in sampling there is no waste of material, apart from the small amount submitted for analysis.

Acknowledgment.

The writer wishes to acknowledge the assistance of Mr Gunn Lay Teik Assistant Analyst, in the analytical work connected with the investigation.

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1. Georgi, C. D. V. and Gunn Lay Teik. Notes on the Preparation of Derris Root for Export together with a Suggested Method of Evaluation. *Malayan Agricultural Journal,* Vol. XXIV, No. 10, October 1936, p. 489.
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Reviews.

Livestock of Southern India.

By R. W. Littlewood, N.D.A., I.A.S., A.I.R.O., Deputy Director of Agriculture, Livestock, Madras. Government Press, Madras, 1936, pp. 239. Rs. 3 ans. 6.

The book describes in great detail the various classes of livestock of Southern India, which includes many breeds of cattle, buffalo, sheep, goats and pigs.

The author, Captain R. W. Littlewood, is Deputy Director of Agriculture, Livestock, Madras, and during his long service in the Madras Presidency has done much to improve the breeding of livestock in that country. Consequently the publication of the present work provides a valuable record of the recent development of livestock breeding under Southern Indian conditions.

The book is profusely illustrated with photographs which help to convey to the reader a fair idea of the various types of livestock described.

In general, it must be concluded that, through the course of time, the so-called breeds of Indian cattle have been evolved to produce the present types owing to the geological formation on which they have been developed, the class of soil with its mineral content having a fundamental bearing on the development of the animals.

The comments on cross-breeding of Ayrshire bulls and Sahiwal and Scindi cows are interesting; it is admitted that cross-bred bulls are disappointing and that the cows are unable to compete with pure bred animals of *Bos indicus* on the usual starvation diet available, but the cows are much sought after by the proprietors of town dairies where the feeding is more liberal.

It is noted that the Madras Government has abandoned the cross-breeding experiments on the score of economy, but herds of Scindi and Ongole cattle are being improved for milk production.

It would appear that the town dairies have little to commend them as the milk they sell is of doubtful quality. They also cause a steady depletion of the best cows from the country districts from which supplies are perpetually drawn to replace young cows sold for slaughter after completing only one lactation.

The mass of detail dealing with the customs of the people associated with livestock rearing tends to make the book rather tedious to read. Furthermore, the continuous use of vernacular names without their translation into English reduces the value of the book to people outside Southern India.

The book does not cover housing, diseases, or parasites, and the section devoted to feeding deals with the subject only in a very general manner. No index is provided, but the book is divided into 37 sections which are detailed in the List of Contents.

At the end of the book are to be found tables giving detailed measurements, colour of skin and colour of hair of the various breeds of cattle previously described in the text. This information is of particular value in classifying the different so-called breeds of Southern Indian cattle.

T. D. M.

Annual Report for 1936 of the Rubber Research Institute of Malaya.

Published by the Rubber Research Institute of Malaya. August 1937. 158 pp. Price $1 (Straits Currency).

Following precedent, Mr. H. J. Page—whose service as Director of the Institute covered the last 4½ months of the year under review—in this Report outlines the activities of the Institute, but leaves the more detailed survey of the range of investigations to the reports of his Heads of Divisions which are also included in the volume.

The development of the research work of the Institute, as set forth in successive annual reports, makes interesting reading, and the fact that the conclusions are stated concisely will appeal to many readers who feel that they do not want to be "burdened" by a description of experiments upon which such conclusions are based.

The year 1936 was an unfortunate one for the Institute, owing to the fire which destroyed the Chemical and Soils Divisions' Laboratories and with them many valuable records, besides greatly disorganizing the work of the Institute for many months. Despite this disorganization, research work made progress in many directions, while the records given of advisory work and the increasing number of visitors to the laboratories and to the Institute's Experimental Station is evidence that the services offered by the Institute are become more widely appreciated.

Reports of the Field Branch for the year 1936.

Special Bulletin, General Series No. 27. Department of Agriculture, Straits Settlements and Federated Malay States. 157 pp. Price 50 cents (Straits Currency).

This volume includes eleven annual reports of officers in charge of agricultural services in the various States and Territories of Malaya. The reports as received have been somewhat abridged for publication by omitting information that is readily available in other Departmental publications.

The Field Branch constitutes an important link in the organization of the Department. Its officers are concerned with experimental work, especially that of testing the behaviour of crops under varying local conditions, and extensional work of an advisory nature. From the present volume the reader will obtain an impression of the very diverse nature of the duties of field officers, and must be impressed with the very great facilities thus provided for the agriculturist—and especially the Asiatic small-holder—to reap the advantages of recent research work.

Departmental.

FROM THE DISTRICTS.

Compiled by the Chief Field Officer from Monthly Reports of Agricultural Officers.

September, 1937.

The Weather.

The dry weather prevailing in August continued over almost the whole of the country during the first part of the month, and the total precipitation for the month was much below average. In Perak exceptionally dry weather was experienced. In the latter part of the month rain occurred in all districts, particularly heavy rain being recorded in the north and north-eastern regions.

In Malacca and Singapore the rainfall was fairly evenly distributed throughout the month and the total precipitation was up to the average.

The only districts where the rainfall was above the average were in Kedah, Kelantan and Pahang.

Remarks on Crops.

Padi.—The transplanting of padi, which had been delayed by the dry weather, was proceeded with as soon as there was rain. In Kedah the growth of padi is well advanced in some areas while nearby, planting is only now taking place. As a result, the harvest is likely to be very protracted. The planting schedule in Kelantan and Perak is generally further advanced than at the same time last year. At Kukub in South Johore harvesting has commenced. In this district some areas have been left uncultivated and prospects are not encouraging. In Malacca transplanting was completed by the end of the month.

In the Raub District increased use is being made of the plough and harrow for cultivation. Further ploughing, *tajak* and nursery demonstrations have taken place.

Throughout the country rat damage is very much less than in previous seasons. The prolonged dry weather has perhaps interfered with the breeding of these vermin.

It is of general interest to learn that His Highness the Sultan of Perak has issued a circular to his subjects advising them to plant padi and food crops in view of prevailing world conditions.

Rubber.—There was little change in the price of rubber during the month; smoked sheet $34 to $38.50 per picul; unsmoked sheet $30 to $36.50 per picul. An average price of $27 per picul was obtained for uncouponed rubber. The price of coupons fluctuated and towards the end of the month rose by as much as $5; prices ranged from $6.50 to $15.

From Penang and Johore it is reported that there is a general increase in the number of holdings in tapping. In Kelantan there is a decrease in the tapping of rubber holdings due to the cultivators transferring their activities to the planting of padi. In this State the price of coupons dropped considerably.

The advent of rain has resulted in outbreaks of Mouldy Rot all over the country. Fungicides have been distributed and treatment is being carried out satisfactorily.

As a result of propaganda and of the activities of the Asiatic Rubber Instructors, everywhere improvement in the preparation of rubber is reported, notably in Kelantan where previously the rubber produced was of very poor quality. The production of sheet as opposed to lump rubber has markedly increased, and sheeting machines are in great demand; also acid is replacing the use of alum for coagulating. The interest of small-holders in smoke cabinets has been maintained and in all districts new cabinets have been erected.

In Brunei the small-holders are taking increased interest in cleanliness and the use of correct utensils for the preparation of their rubber. No less than 181 new smoke cabinets are in use in this State. In Johore there is a disappointing lack of interest amongst small-holders in the use of smoke cabinets.

At Sungei Selansek, Selangor, a premium of $5 to $7 per picul is being paid by dealers for smoked over unsmoked sheet.

The marked success which the Asiatic Rubber Instructors have experienced when assisting small-holders is due mainly to the fact that the small-holders need but little persuasion to adopt the correct method of preparation of their rubber. Small-holders generally make a bad quality product because they do not know the correct method of manufacture, or because the machines or other requisites of manufacture are not available to them.

Coconuts.—The price of nuts and copra declined slightly, but there was a tendency for the price to harden towards the end of the month and trade was brisker.

In Pahang an attempt is being made to persuade dealers to buy copra according to grades, which, if successful, should encourage the production of good copra. In Johore and Labuan much interest is being taken in the use of improved kilns for making copra. In these districts dealers pay a higher price for copra from these kilns. There is no doubt that well-prepared copra will command a premium over the badly-prepared copra at present so general in the villages.

A coastal bund bordering the Sabak Bernam peninsula, commenced in 1934 by the Drainage and Irrigation Department was completed this year. A survey of the area affected by the bund is being made, and enquiries to-date show that coconut holdings at Sungei Ayer Tawar and Sungei Long, previously barren, are now yielding 300 to 600 nuts per acre per 2 months' plucking and similar holdings at Simpang Ampat and Bunting in Bagan Nakhoda Omar are yielding 150 to 300 nuts.

The Rantau Panjang bund in the Klang District has also improved coconut holdings in its vicinity. Small-holders state that nut size has increased as well as yield; 1,000 nuts now produce 4 piculs of copra instead of 3 piculs previously; and five nuts now produce 1 pint of oil as compared with seven nuts previously.

Pineapples.—Only a small quantity of fruit was available and factories in Johore and Singapore were operating on short time only.

Sago.—A survey of all the sago planted in Brunei is being carried out. Large areas of the palms exist and attempts will be made to encourage systematic cultivation of this crop.

Educational Tour.

A part of twenty headmen and selected cultivators from the Raub District together with the Malay Agricultural Assistant and the Senior Co-operative Officer, Pahang, made a six-days tour through Negri Sembilan, Malacca and Selangor during August. Besides visiting a number of padi Test Plots, Agricultural Stations and selected kampongs, visits were paid to the Farm School, Malacca, Central Experiment Station, Serdang, the Rubber Research Institute Experiment Station at Sungei Buloh, Malay Regiment at Port Dickson, historical buildings in Malacca, Kuala Lumpur Museum and Botanic Gardens, and various places such as rice and oil mills, dairy farm, and tobacco factory in Malacca.

Agricultural and Padi Stations.

Agricultural Stations.—There is a demand for stock of good quality fruit, the demand exceeding the supply. At Selama and Tangkak Agricultural Stations plans have been prepared to extend considerably the area under proved varieties of fruit. In other Stations nurseries are being planted to provide stock for budding.

Padi Test Stations.—Transplanting of padi in the Plots in Kedah is completed and at all the other Stations is well advanced. Shortage of water has caused delay at some Stations.

At Kota Bharu Experiment Station tube well irrigation has proved of considerable value in supplementing the rainfall. At Bachok and Pasir Mas Agricultural Stations the sandy nature of the soil and the shortage of water made cultivation impossible, so that the long-term varieties of padi have not yet been transplanted.

From Brunei it is reported that the Padi Test Stations are having a considerable influence on the methods of padi cultivation in the surrounding areas.

DEPARTMENTAL NOTES.

New Laboratories for the Department of Agriculture.

The main building of the headquarters offices of the Department of Agriculture, S.S. and F.M.S., situated in the Gardens, Kuala Lumpur, was constructed when the Department was inaugurated in 1905. This building was amply large enough for the small initial staff of the Department, but with the rapid development of recent years, and a considerably increased staff, it was found necessary to extend available accommodation by the erection of temporary laboratories and offices, and by the conversion of a bungalow in the vicinity of headquarters.

Plans have recently been approved for the construction of modern laboratories to house the whole of the Research Branch of the Department, and already one building is in course of erection. There will be four new laboratories provided in two 2-storey buildings adjoining the existing headquarters offices. In one building, on the ground floor, will be accommodated the Chemistry Branch, and on the upper floor the Soils and Plant Physiology Chemist and staff. The other building will provide laboratories on the ground floor for the Plant Pathologists and Botanists and on the upper floor for the Entomological Branch.

The rooms vacated in the existing building will permit of the more satisfactory housing of the Department's library which has long suffered from insufficient space, and of increased accommodation for the Chemist Coconut Products, Agriculturist, and State Agricultural Officer, Selangor.

Rural Lecture Caravan.

The Rural Lecture Caravan visited four centres in the Lipis District from the 26th August to 2nd September. The Caravan then toured East Pahang from the 3rd to the 28th September.

Leave.

Mr. W. N. C. Belgrave, Chief Research Officer, returned from leave on 10th September 1937. Consequent upon his return to duty, Mr. B. Bunting resumed duty as Senior Agriculturist.

Statistical.

MARKET PRICES.

September, 1937.

Major Crops.

Rubber.—The market continued relatively stable during the greater part of the month, but weakened at the close. Spot loose opened in Singapore at 30⅛ cents per lb., and improved to 30⅞ cents on the 9th and again on the 13th September; it subsequently fell to 29¾ cents on the 21st, and closed at 28¾ cents.

The average Singapore price for the month for No. 1. X. Rubber Smoked Sheet was 30.16 cents per lb. as compared with 29.94 cents in August. The London average price was 8.95 pence per lb. and the New York price 18.49 cents gold, as compared with 8.82 pence and 18.29 cents gold in August.

Prices for small-holders' rubber at three centres during the month are shewn in Table I.

Table I.

Weekly Prices Paid By Local Dealers for Small-Holders' Rubber, September, 1937.

(Dollars per Picul.)

Grades.	Kuala Pilah, Negri Sembilan.				Kuala Kangsar, Perak.				Batu Pahat, Johore.				
	2	9	16	23	8	15	22	29	1	8	15	22	29
Smoked sheet	37.00	37.37			37.75	37.00	36.69	36.03	35.00	34.30	36.00		34.20
Unsmoked sheet			35.50						32.40	33.00	32.50	33.10	31.30
Scrap		22.00	22.00	23.00				32.00					

Transport by F.M.S.R. lorry service Kuala Pilah to Seremban 12 cents per picul, to Malacca excluding duty, 25 cents per picul, by rail Seremban to Penang $1.24 per picul, Seremban to Singapore $8.00 per ton.

Transport from Batu Pahat to Singapore by lorry excluding duty, 90 cents per picul.

Transport from Kuala Kangsar to Prai by railway $6.20 per ton.

Transport from Kuala Kangsar to Singapore by railway $10.00 per ton (minimum consignment 5 tons).

At Kuala Pilah the standard deduction for moisture in unsmoked sheet is 5 per cent.

At Kuala Kangsar the standard deduction for moisture in unsmoked sheet is 10 per cent.

No purchases at Kuala Kangsar on the 1st September, and at Kuala Pilah on the 30th September.

Palm Oil.—The market fell still further during September as shewn in Table II

Table II.
Prices of Palm Oil and Palm Kernels.

Date 1937.	Palm Oil in Bulk, c i.f. landed weight Liverpool/ Halifax.	Palm Kernels, c.i.f. landed weight London/ Continent
	per ton	per ton
September 3	£ 18. 10. 0	£ 10. 10. 0
,, 10	18. 10. 0	10. 12. 6
,, 17	18. 10. 0	10. 10. 0
,, 24	18. 0. 0	10. 12. 6

Copra.—The Singapore market fell still further at the beginning of the month, but in the second half improved steadily and was still rising at the close. The sun-dried grade opened at $5.05 per picul, and in the first few days fell to $4.90; after a slight improvement the price again weakened on the 14th September to $5, thereafter improving to $5.60 at the close. The average price for the month was $5.14 per picul as compared with $5.69 in August. The mixed grade averaged $4.88 per picul as compared with $5.39 in the previous month.

Copra cake weakened to $2.40 per picul, averaging $2.42 for the month.

Rice.—The average wholesale Singapore prices of rice per picul in August were as follows:— Siam No. 2 (Ordinary) $4.79, Rangoon No. 1 $3.92, Saigon No. 1 $4.12, as compared with $4.08, $3.55 and $3.72 in July, and $3.85, $3.47 and $3.57 in August 1936.

The average retail prices in cents per gantang of No. 2 Siam rice in August were: Singapore 29, Penang 40, Malacca 34, as compared with 28, 36 and 42 in July.

The average declared trade value of imports during August was $3.97 per picul, as compared with $3.78 in July and $3.90 in June.

Padi.—The price of padi remained at $2 per picul at the Government Rice Mills, Perak. Retail prices of padi ranged from 9 to 17 cents per gantang.

Pineapples.—Prices were increased by the Packers' Combine but demand was poor pending the commencement of the new packing season. The range of prices per case was: G.A.Q.: Cubes $3.10, Sliced Flat $3, Sliced Tall $3.15; Golden Quality: $3.35, $3.35 and $3.45 respectively.

Prices of fresh fruit per 100 during September were as follows:—Selangor 60 to 85 cents, Singapore $2.50; Johore 1st quality $1.80 to $2.50, 2nd quality $1.50 to $2.10, 3rd quality 80 cents to $1.50.

Beverages.

Tea.—Eleven consignments of Malayan tea were sold on the London market during September; three were of upland tea and eight of lowland tea. The former were sold at prices averaging from 1s. 2¾d. to 1s. 3¾d., and the latter from 1s. 0¾d. to 1s. 3d.

Average London prices per lb. during September for consignments of tea from other countries were as follows:—Ceylon 1s. 4.48d., Java 1s. 3.26d., Indian Northern 1s. 5.16d., Indian Southern 1s. 3.15d., Sumatra 1s. 1.17d.

The latest Colombo average prices available quoted from *The Weekly Tea Market Report*, 28th September 1937, of the Colombo Brokers' Association, are as follows, in rupee cents per lb.:—High Grown Teas 80 cents, Medium Grown Teas 76 cents, Low Grown Teas 73 cents.

Coffee.—Prices were lower during September in Singapore and averages for the month were: Sourabaya $12.81 to $14.81 per picul, Palembang $10.69 to $12.75. The August prices were $17.45 to $18.45 and $13.35 to $14.35 respectively.

Prices in Singapore of other varieties of coffee were as follows (per picul):—Liberian $18, Excelsa $12, Robusta $10.

Spices.

Arecanuts.—The following was the range of Singapore average prices per picul during September: Splits $6.62 to $8.56; Red Whole $6.38 to $8.38; Sliced $11.12 to $13.75.

The averages of the Singapore Chamber of Commerce quotations per picul were: Best $7.94, Medium $7.44, Mixed $6.69.

Pepper.—There was a further slight improvement in the Singapore market during the month. Average prices per picul were: Singapore Black $11, Singapore White $16.75, Muntok White $17.25, as compared with $9.44, $16.50 and $17 respectively in August.

Nutmegs.—Both 110's and 80's improved considerably from $35 per picul in August to $40 in September. The average price for the month was $39.25.

Mace.—Prices continued unchanged throughout the month at: Siouw $100 and Amboina $85 per picul.

Cloves.—Quotations remained nominal and unchanged at $40 per picul for both Zanzibar and Amboina.

Cardamoms.—Quotations for green cardamoms in the September Ceylon Chamber of Commerce reports ranged from Rs. 2.10—Rs. 2.28 to Rs. 2.15—Rs. 2.29 per lb.

Miscellaneous.

Derris (*Tuba Root*).—The Singapore market continued dull throughout the month and the price of roots sold on rotenone content fell to $38 per picul as compared with $42 in August. Roots sold on a basis of ether extract remained unchanged at $20 per picul.

Gambier.—Block improved to average $9.50 per picul as compared with $9.25 in August. No. 1 Cube weakened slightly, averaging $15.25 per picul as compared with $15.88 in the previous month.

Tapioca.—Singapore average prices per picul for the month were:— Flake Fair $5.08, Seed Pearl $5.20, Medium Pearl $5.60, as compared with $4.82, $5.29 and $5.60 in August.

Sago.—Singapore prices improved during September and averages per picul were: Pearl, Small Fair $5.36, Flour, Sarawak Fair $3.21. August average prices were $5.25 and $3.14 respectively.

Tobacco.—The range of prices per picul was as follows:—1st quality $23 to $45, 2nd quality $15 to $35, 3rd quality $10 to $25. Prices of prepared tobacco in Kelantan were: $100, $75 to $100, $50 to $70.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports and certain coffee prices are kindly supplied by Messrs. Guthrie & Co. Ltd., Kuala Lumpur; the Singapore prices for imported coffee and arecanuts by the Lianqui Trading Company of Singapore, and derris prices by Messrs. Kohyei & Co., Singapore.

1 picul = 133⅓ lbs. The Dollar is fixed at two shillings and fourpence.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57 Trafalgar Square, London, W.C. 2

GENERAL RICE SUMMARY*

August, 1937.

Malaya.—Imports of foreign rice during August were 72,905 tons,† and exports 8,920 tons; net imports were therefore 63,985 tons as compared with 50,499 tons in 1936. Net imports from January to August totalled 381,505 tons as compared with 356,588 tons in 1936.¶

Of the August imports 47 per cent. were consigned to Singapore, 13 per cent. to Penang, 7 per cent. to Malacca, 25 per cent. to the Federated Malay States, and 8 per cent. to the Unfederated Malay States. The foreign imports by countries of origin were as follows (in tons, percentages in brackets):—Siam 36,513 (50.1), Burma 28,094 (38.5), French Indo-China 7,083 (9.7), other countries 1,215 (1.7).

Of the exports during August 58 per cent. were consigned to the Netherlands Indies, and 42 per cent. to other countries. The various kinds of rice exported were as follows (in tons, percentages in brackets):—Siam 7,782 (87.2), Burma 470 (5.3), French Indo-China 596 (6.7), parboiled 43 (0.5), local production 29 (0.3).

The following table gives the acreages of padi planted and yields (converted into tons of rice) for the season 1936-37, together with corresponding figures for the previous season 1935-36.

Territory.	Acres		Rice (in tons)	
	1936-37	1935-36	1936-37	1935-36
Federated Malay States ...	185,730	178,020	76,944	74,221
Straits Settlements ...	69,090	67,750	35,794	35,982
Unfederated Malay States ...	485,220	479,280	190,990	215,330
Total Malaya ...	740,040	725,050	303,728	325,533

India and Burma.—Foreign exports for the period January to July totalled 610,000 tons as compared with 873,000 tons in 1936, a decrease of 30.1 per cent. Of these exports 4.3 per cent. were to the United Kingdom, 6.2 per cent. to the Continent of Europe, 27.4 per cent. to Ceylon, 22.9 per cent. to the Straits Settlements and the Far East, and 39.2 per cent. to other countries. The corresponding 1936 percentages were 3.9, 19.3, 27.7, 19.9 and 29.2.

* Abridged from the Rice Summary for August 1937, compiled by the Department of Statistics, Straits Settlements and Federated Malay States.

† Ton = long ton (2,240 lbs.)

¶ It is to be understood throughout the summary that all comparisons and percentage increases or decreases are in relation to the corresponding period of 1936.

Siam.—Exports of rice and rice products from Bangkok during June were 60,949 tons as compared with 123,472 tons in 1936.

Japan.—The final figures published by the Formosan Government for the first rice crop of 1937 gives the total yield as 618,711 tons, as compared with 664,559 tons in 1936, and 607,014 tons in 1935. This figure is 1.5 per cent. above the average yield of the first crop for the past five years.

French Indo-China.—Entries of padi into Cholon from January to August totalled 1,115,341 tons as compared with 1,175,405 tons in 1936, a decrease of 5.1 per cent. Exports of rice during the same period were 1,076,989 tons as compared with 1,230,992 tons in 1936, a decrease of 12.5 per cent.

The Netherlands Indies.—The latest information available was published in the May Summary.

Ceylon.—Imports from January to August totalled 360,267 tons as compared with 354,436 tons in 1936, an increase of 1.6 per cent. Of these imports 17.1 per cent. were from British India, 70.2 per cent. from Burma, 0.1 per cent. from the Straits Settlements, and 12.6 per cent. from other countries. Corresponding 1936 percentages were 13.4, 62.6, 0.5 and 23.5.

Europe and America.—Shipments from the East to Europe from the 1st January to the 3rd August totalled 808,761 tons as compared with 820,573 tons in 1936, a decrease of 1.4 per cent. Of these shipments 45.2 per cent. were from Burma, 47.7 per cent. from Saigon, 5.0 per cent. from Siam, and 2.1 per cent. from Bengal. The relative percentages for 1936 were 31.4, 60.2, 7.3 and 1.1.

Shipments to the Levant from 1st January to 2nd August totalled 11,203 tons, an increase of 30.8 per cent. as compared with 8,563 tons in 1936. Shipments for Cuba, West Indies and America from the 1st January to the 17th July aggregated 174,649 tons as compared with 161,124 tons in 1936, an increase of 8.4 per cent.

MALAYAN AGRICULTURAL EXPORTS, AUGUST, 1937.

PRODUCT.	Net Exports in Tons				
	Year 1936	Jan.-Aug. 1936	Jan.-Aug. 1937	August 1936	August 1937
Arecanuts ...	26,548	20,357	20,494	3,023	656
Coconuts fresh † ...	114,314†	78,432†	59,205†	8,297†	5,796†
Coconut oil ...	46,507	30,653	25,407	4,123	4,013
Copra ...	76,681	44,617	40,520	12,290	2,767
Gambier, all kinds ...	2,188	1,403	1,304	115	171
Copra cake § ...	20,438§	13,538§	9,507§	1,418§	1,487§
Palm kernels ...	4,964	2,743	4,104	378	645
Palm oil ...	29,296	17,945	28,168	4,529	5,785
Pineapples canned ...	76,403	60,568	64,589	5,674	8,723
Rubber ¶ ...	365,005¶	234,729¶	320,845¶	31,219¶	48,383¶
Sago,—flour ...	6,180	5,527	8,514	2,042	942
,, —pearl ...	3,319	2,126	2,111	252	389
,, —raw ...	7,484*	4,775*	5,289*	648*	816*
Tapioca,—flake ...	1,535	1,130	717	128	65
,, —flour ...	2,418*	1,328*	1,313*	159*	247*
,, —pearl ...	17,797	11,609	10,044	2,279	1,577
Tuba root ...	599	439	432	34	46

† hundreds in number. * net imports. ¶ production. § gross exports.

MALAYAN PRODUCTION OF PALM OIL AND KERNELS

(In long tons, as declared by Estates)

Month 1937	Palm Oil		Palm Kernels	
	F.M.S.	U.M.S.	F.M.S.	U.M.S.
January ...	1,984.8	865.0	360.4	156.0
February ...	1,759.6	1,851.8	323.6	308.7
March ...	1,798.4	1,473.4	358.7	256.1
April ...	1,573.1	1,237.2	308.0	226.0
May ...	1,587.6	1,285.2	257.8	186.4
June ...	1,671.8	1,611.7	288.9	252.5
July ...	2,651.0	1,860.5	411.6	269.6
August ...	3,767.7	1,762.2	616.8	274.0
Total ...	16,794.0	11,947.0	2,925.8	1,929.3
Total January to August, 1936 ...	14,353.5	4,988.0	2,307.6	785.9
Total for the year 1936 ...	23,081.2	8,812.3	3,791.0	1,340.7

Stocks on estates at the 31st August, 1937 were: palm oil 2,885 tons; palm kernels 728 tons.

ACREAGES OF TAPPABLE RUBBER ACTUALLY TAPPED AND NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING 31ST AUGUST, 1937.

STATE OR TERRITORY	Estimated Acreages of Tappable Rubber	Actual area tapped during the month Acreage	Percentage of (3) to (2)	ACREAGES OF TAPPABLE RUBBER NOT TAPPED				AREA OF TAPPABLE RUBBER NEVER BEEN TAPPED		Total area not tapped (5) + (7)	Percentage of (11) to (2)
				ESTATES WHICH HAVE ENTIRELY CEASED TAPPING		ESTATES WHICH HAVE PARTLY CEASED TAPPING (*a*)					
				Acreage	Percentage of (5) to (2)	Acreage	Percentage of (7) to (2)	Acreage	Percentage of (9) to (2)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
STRAITS SETTLEMENTS :—											
Province Wellesley ...	43,755	27,920	63.8	338	0.8	15,497	35.4	318	0.7	15,835	36.2
Malacca ...	123,605	85,026	68.8	512	0.4	38,067	30.8	2,484	2.0	38,579	31.2
Penang Island ...	2,591	1,830	70.6	—	—	761	29.4	75	2.9	761	29.4
Singapore Island ...	32,659	21,381	65.5	973	3.0	10,305	31.5	125	0.4	11,278	34.5
Total S.S. ...	202,610	136,157	67.2	1,823	0.9	64,630	31.9	3,002	1.5	66,453	32.8
FEDERATED MALAY STATES :—											
Perak ...	292,048	221,759	75.9	1,218	0.4	69,071	23.7	7,780	2.7	70,289	24.1
Selangor ...	332,604	253,897	76.3	2,631	0.8	76,076	22.9	10,816	3.3	78,707	23.7
Negri Sembilan ...	259,081	189,897	73.3	2,458	0.9	66,726	25.8	9,588	3.7	69,184	26.7
Pahang ...	84,004	62,512	74.4	3,599	4.3	17,893	21.3	9,815	11.7	21,492	25.6
Total F.M.S. ...	967,737	728,065	75.2	9,906	1.0	2 29,766	23.8	37,999	3.9	239,672	24.8
UNFEDERATED MALAY STATES :—											
Johore ...	469,610	348,520	74.2	3,507	0.8	1 17,583	25.0	39,018	8.3	121,090	25.8
Kedah ...	200,154	151,360	75.6	3,430	1.7	45,364	22.7	8,935	4.5	48,794	24.4
Kelantan ...	28,407	22,163	78.0	403	1.4	5,841	20.6	3,374	11.9	6,244	22.0
Trengganu (*b*) ...	4,817	3,044	63.2	—	—	1,773	36.8	100	2.1	1,773	36.8
Perlis ...	1,330	651	48.9	482	36.3	197	14.8	107	8.0	679	51.1
Brunei ...	5,564	3,618	65.0	1,140	20.5	806	14.5	821	14.8	1,946	35.0
Total U.M.S. ...	709,882	529,356	74.6	8,962	1.2	1 71,564	24.2	52,355	7.4	180,526	25.4
Total Malaya ...	1,880,229	1,393,578	74.1	20,691	1.1	4 65,960	24.8	93,356	5.0	486,651	25.9

Notes :—(*a*) Area out of tapping on estates which have partly ceased tapping refers to areas definitely being rested and includes areas rested under rotational systems, but excludes areas on any tapping round in respect of Perlis only.
(*b*) Registered companies only.

MALAYAN RUBBER STATISTICS — TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF AUGUST, 1937, IN DRY TONS.

State or Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports				Exports including re-exports				Stocks at end of month			Consumption 3	
								during the month		Jan. to Aug. 1937		during the month		Jan. to Aug. 1937						
	Ports	Dealers	Estates of 100 acres and over	during the month	Jan. to Aug. 1937	during the month	Jan. to Aug. 1937	Foreign	From Malay States & Labuan	Foreign	From Malay States & Labuan	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over	during the month	Jan. to Aug. 1937
1																				
MALAY STATES :—	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Federated Malay States ...	...	9,608	14,276	15,157	107,000	9,885	57,315	Nil	Nil	Nil	Nil	18,210	6,367	115,829	42,274	...	10,128	14,205	16	129
Johore ...	...	3,172	5,625	6,556	46,263	5,119	32,812	Nil	25	Nil	2,255	4,005	8,172	26,447	53,429	...	3,217	5,103	...	...
Kedah ...	...	668	3,512	3,726	25,971	1,676	10,067	Nil	Nil	Nil	Nil	1,990	3,325	16,700	18,989	...	717	3,550	...	...
Perlis ...	...	28	13	18	111	35	194	Nil	Nil	Nil	Nil	Nil	48	Nil	281	...	32	14	...	...
Kelantan ...	...	917	342	442	2,973	970	6,200	Nil	Nil	Nil	Nil	396	1,120	2,458	6,044	...	754	401	...	...
Trengganu ...	...	55	50	425	2,321	212	1,161	Nil	Nil	Nil	Nil	Nil	637	Nil	3,482	...	55	50	...	...
Brunei ...	...	8	54	59	478	94	669	...	...	...	...	...	154	...	1,122	...	12	59	...	...
Total Malay States	...	14,456	23,872	26,393	185,117	17,991	108,418	Nil	25	Nil	2,255	24,601	19,823	161,434	125,621	...	14,915	23,382	16	129
S. SETTLEMENTS :—																				
Malacca ...	...	1,618	1,209	1,553	11,064	933	5,911	Nil		Nil		3,811		24,347		...	2,183	1,163	...	...
Province Wellesley ...	...	1,123	725	621	4,320	357	2,190	Nil		Nil		9,184		67,032		...	2,147	724	...	...
Penang ...	2,271	4,619	13	23	146	137	951	2,697	19,445	24,494	120,890		Nil		Nil	2,412	5,152	12	...	...
Singapore ...	8,469	29,417	229	212	1,438	145	1,150	18,633		131,267		26,929		187,451		7,106	33,216	212	37	252
Labuan ...	...	25	Nil	Nil	Nil	18	140	68		420		Nil		Nil		...	37	Nil	...	...
Total Straits Settlements ...	10,740	36,802	2,176	2,409	16,968	1,590	10,342	21,398	19,445	156,181	120,890	39,924	Nil	278,830	Nil	9,518	42,735	2,111	37	252
Total Malaya ...	10,740	51,258	26,048	28,802	202,085	19,581	118,760	21,398	19,470	156,181	123,145	64,525	19,823	440,264	125,621	9,518	57,650	25,493	53	381

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Kedah
22	23	24	25	26	27	28
DRY RUBBER	8,269	31,889	4,910	4,080	2,492	216
WET RUBBER	1,859	1,327	242	299	725	501
TOTAL ...	10,128	33,216	5,152	4,379	3,217	717

TABLE III
FOREIGN EXPORTS

PORTS	For month	Jan. to Aug. 1937
29	30	31
Singapore ...	44,217	292,974
Penang ...	14,067	102,474
Port Swettenham.	6,078	43,053
Malacca ...	163	1,763
MALAYA ...	64,525	440,264

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	Jan. to Aug. 1937
32	33	34
Malay States ...	44,256	284,660
Straits Settlements	4,001	27,165
MALAYA ...	48,257	311,825

Notes:—

1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.
2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month. + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + [20] − [2] − [3] − [4] − [5] − [9] − [10]. For the Straits Settlements the production of estates of less than 100 acres is represented by sales or exports as shown by cess paid.
3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15% wet sheet, 25% scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.
4. Columns (33) and (34) represent exports of rubber subject to regulation which, for Singapore and Penang Islands are represented by sales or exports as shown by cess paid.
5. All statements are brought up to date monthly, and any inaccuracies that may be disclosed are corrected in the totals; the latest publication therefore, is always the most reliable.
6. The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S and F.M.S., at Singapore on 24th September, 1937.

METEOROLOGICAL SUMMARY, MALAYA, AUGUST, 1937.

Locality.	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine.		
	Means of		Mean of A and B	Absolute Extremes						Total.		Most in a day.	Number of days.					Total.	Daily Mean.	Per cent.
	A. Max.	B. Min.		Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet				Precipitation .01 in or more	Precipitation, .04 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more			
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.						hrs.	hrs.	
Railway Hill, Kuala Lumpur, Selangor ...	91.1	71.7	81.4	95	69	88	74	83.5	84.5	6.55	166.4	1.93	14	12	1	1		199.20	6.43	53
Bukit Jeram, Selangor ...	90.5	73.2	81.9	93	71	87	76	86.1	87.2	1.66	42.2	1.18	8	6				240.20	7.75	63
Sitiawan, Perak ...	90.5	72.8	81.7	94	69	82	75	84.4	85.1	1.80	45.7	0.63	6	5	1			226.20	7.30	60
Temerloh, Pahang ...	91.2	71.9	81.5	94	69	88	74	86.2	86.6	2.56	65.0	1.72	9	6	1	8		219.30	7.07	58
Kuala Lipis, Pahang ...	90.1	71.1	80.6	94	68	82	74	84.5	85.3	3.84	97.5	1.59	13	9		23		195.55	6.31	52
Kuala Pahang, Pahang ...	87.3	73.9	80.6	89	71	85	76	87.5	87.9	5.14	130.6	1.28	9	9				265.95	8.58	70
Kallang Aerodrome, S'pore ...	86.4	78.4	82.4	89	73	83	81	83.7	84.3	4.55	115.6	1.78	14	11	4			226.50	7.31	60
Butterworth, Province Wellesley ...	87.8	74.3	81.1	90	72	82	77	85.5	86.0	5.16	131.1	2.25	14	11	1			207.50	6.69	54
Bayan Lepas Aerodrome Penang ...	87.3	74.7	81.0	89	72	82	77	84.4	85.0	7.76	197.1	1.70	14	9	4		1	205.75	6.64	54
Bukit China, Malacca ...	85.8	73.8	79.8	88	70	83	76	83.7	84.5	6.51	165.4	1.69	14	13	4		1	211.95	6.84	56
Kluang, Johore ...	88.6	71.1	79.9	92	67	85	75	81.5	82.4	5.02	127.5	1.22	18	14	2	3		207.95	6.71	55
Bukit Lalang, Mersing, Johore	87.7	71.7	79.7	91	69	85	75	82.2	82.1	5.19	131.8	1.42	16	13	1	1		239.55	7.73	63
Alor Star, Kedah ...	88.3	73.8	81.1	92	72	82	76	84.8	85.8	7.08	179.8	1.74	16	14		1		208.35	6.72	55
Kota Bahru, Kelantan ...	90.1	73.5	81.8	93	72	86	77	85.4	85.8	5.78	146.8	2.18	15	14	4	1		222.75	7.19	58
Kuala Trengganu, Trengganu	88.6	73.3	80.9	91	70	86	75	83.6	84.9	10.61	269.5	5.15	11	11	7			233.65	7.54	61
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	75.5	62.9	69.2	79	61	72	64	72.3	72.6	2.67	67.8	1.18	13	10		17	1	195.75	6.31	52
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	72.2	55.2	63.7	75	50	68	61	69.9	70.1	3.97	100.9	0.74	17	13	2	3		161.35	5.20	42
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ...	72.3	59.6	65.9	78	57	67	61			4.02	102.1	1.21	16	15	2	3		175.35	5.66	46

Compiled from Returns supplied by the Meteorological Branch, Malaya.